

MEMORANDUM OF AGREEMENT
between
DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
AND
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
concerning
WAKE TURBULENCE RESEARCH AND DEVELOPMENT

1. PURPOSE

The Federal Aviation Administration (FAA) and the National Aeronautics and Space Administration (NASA) are committed to a close partnership in the pursuit of complementary goals in aviation and future space transportation. These goals include aviation safety, airspace system efficiency, environmental compatibility, and others. It has been agreed to facilitate this partnership, the agencies will coordinate their planning efforts and senior management will establish and monitor collaborative activities necessary to accomplish these goals.

The purpose of this Memorandum of Agreement (MOA) is to build upon and expand the long-standing research and development (R&D) relationship between the FAA and NASA in the area of wake turbulence research. Specifically, this MOA forms the basis upon which the FAA and NASA may establish plans and carry out programs to achieve the joint national goals of increasing airport capacity through the application of appropriate procedures and technology. This MOA is written in accordance with the guidelines established by FAA/NASA Memorandum of Understanding, FN7 - Airspace System User Operational Flexibility and Productivity, dated September 11, 1995.

2. BACKGROUND

Wake vortices that trail from an aircraft in flight can cause an upset to another aircraft that encounters the first aircraft's wake vortices. This is often called wake turbulence. The wake hazard has been mitigated by the enforcement of required wake separation distances between aircraft. Research to date has shown that aircraft created wake vortices can transport laterally and vertically – depending on atmospheric conditions and aircraft characteristics. Advances in wake vortex understanding and tracking have the potential of allowing more safe, airport efficient spacing of arriving and departing aircraft – which would translate into a higher air traffic capacity for airports that are being stressed by increased traffic demands.

With the expanding demand for air transportation services and the massive capital expenditure required to add runways to our existing airports or to build additional airports in our metropolitan areas (areas of highest demand for air transportation services), FAA and NASA are working together to make the maximum safe use of the nation's existing

runways. In many weather situations, the existing wake separation requirements cause an airport to operate a lower capacity than dictated by the physical design of the airport. For example, Cleveland Hopkins airport (CLE) normally utilizes its closely spaced parallel runways. However, when weather requires the use of instrument approaches, wake vortex spacing requirements cause CLE to use only one of two parallel runways and to increase the spacing between arriving aircraft. The result is that CLE loses nearly 50% of its landing capacity in weather situations that dictate the use of instrument landing procedures.

NASA and FAA have complimentary research and development programs aimed at the common objective of maintaining the optimal use of airport runways in all weather conditions. The FAA's program is focused on gathering sufficient data on the wake vortex behavior of landing and departing aircraft to determine if more runway efficient wake separation procedures can be safely applied. Successful outcome of the FAA's research program would be a wake separation procedural change allowing more utilization of the runway, while insuring no hazardous wake encounters. Implementation of the research results would be within several years since no system development (hardware or software) would be required. The NASA research program is looking at a broader, more technology intensive set of solutions for safely gaining more capacity at our existing airports and runways. These solutions will take longer to develop and then implement. FAA will partner with NASA in this longer-term work. Wake vortex data collected by the FAA for its procedural changes will be utilized by NASA in its development of airport capacity increasing tools/processes. As NASA proceeds in its development of solutions, FAA will provide NASA with system interface and implementation platform requirements. FAA will also be involved in the evaluation of the NASA developments.

3. SCOPE/OBJECTIVE

The FAA and NASA will focus their efforts on defining tasks to meet the overall goals and objectives of this MOA, and on ensuring that a coordinated series of activities are undertaken in the area of wake turbulence research. The scope of the joint FAA/NASA Wake Turbulence Research Program is defined by the program's "Wake Turbulence Research Management Plan" (RMP); which outlines near, mid, and long-term research activities.

Together, the FAA and NASA will co-lead the development of a joint broad-based wake turbulence research and development program focused on providing runway and airway efficient wake mitigation solutions and whose scope potentially could include the following activities:

- Develop ground-based technology and procedures to allow increased safe utilization of closely spaced parallel runways in low visibility conditions.
- Develop ground-based technology and procedures to increase safe utilization of single runways

- Investigate air-based technology for tracking and displaying location/intensity of other aircraft wakes
- Investigate techniques for reducing the wake vortices created by aircraft
- Investigate wake turbulence impacts of increased use of Required Navigation Performance (RNP) procedures and implementation of Domestic Reduced Vertical Separation Minimum (DRVSM)

4. STATEMENT OF WORK

The FAA and NASA will define tasks to meet the overall goals/objectives of this MOA to ensure a coordinated series of activities to improve flight safety and increase airport capacity and productivity. Individual statements of work (SOW) for the potential activities described below may include agreements for temporary detail of personnel between agencies when necessary; use of major facilities – including appropriate test facilities; funding approaches and authorization – including transfer of funds between agencies; and mechanisms for working with contractor teams. Each SOW will fully describe (content, delivery date, reviewer/approver) its expected deliverables. Resources (i.e. personnel, facility usage, annual funding) to accomplish the work will be identified in the SOW.

A. ACTIVITIES

In the attempt to increase capacity in the National Airspace System (NAS), the FAA and NASA will perform the following activities listed below. Along with these research activities, program efforts must assure that any potential increase in NAS capacity is achieved safely. The activities listed below are examples of potential activities the joint FAA/NASA Wake Turbulence Research Program and other FAA/NASA collaborative programs could accomplish under this MOA:

1. Enhance utilization of existing closely spaced parallel runway (CSPR) during airport low visibility conditions. FAA, NASA and industry would conduct the necessary data collection and analyses to determine whether existing CSPR runways can be safely utilized for dependent (possibly independent) instrument approaches during low visibility conditions, allowing the airport to have a higher arrival rate than it presently does for these conditions. If analyses prove sufficient benefit potential, work would continue in the development, prototyping, validation and implementation of the processes, procedures, decision tool aids, additional sensors and navigation aids required to make the enhancement operational.
2. Utilize technology to safely reduce the wake separation requirements for departing aircraft on the same and adjacent (parallel and intersecting) runways. Activity would involve wake turbulence sensor adaptation for tracking wakes of departing aircraft; data collection to understand and characterize behaviors of wakes from departing aircraft; and, analyses for potential benefits/costs of reducing the “wake” waiting time for departing aircraft. If potential benefits look promising, work will continue into the development of the systems and procedures required to realize these benefits.

3. Evaluate the impact of weather conditions on the travel and degradation of aircraft wake vortices. This activity would be done in concert with other wake turbulence data collection/analysis efforts. Major output would be an understanding and supporting model of how airport weather conditions impact the required wake spacing between aircraft, both for arrivals and departures. Ideally, the results would be sufficiently general in nature that they can be used for other similar airports without the need for an extensive wake turbulence transport data collection/analysis effort for each implementing airport.
4. Determine if a capability to dynamically regulate aircraft wake separations based on surrounding weather conditions, would be an effective tool to safely increase the air traffic capacity of the NAS. This activity would utilize the data and analyses of prior wake turbulence collection efforts to determine feasibility. If assessment proves promising, activity would develop a more detailed concept of use, prototype procedures modeling/simulations, and a prototype spacing tool. Evaluations would then follow. If successful, the joint activity would move into the procedure/tool implementation phase.
5. Determine wake impact of new aircraft (i.e. A380) on aircraft wake separation processes and associated criteria. New aircraft designs will require the revision/update of existing wake encounter risk models. This activity would accomplish the required model revisions and subsequent re-validation.
6. Develop aircraft modifications that reduce the aircraft's wake vortices. Activity would create designs and/or flight procedures that maintain or improve aircraft performance while at same time reduce the aircraft's wake vortices. If the research activity is successful, innovations will be made available in accordance with Government policies on technology transfer.
7. Obtain aviation industry review and approval. The FAA/NASA Wake Turbulence Research Program would coordinate with the aviation industry, especially with pilot and air traffic control labor groups to ascertain their needs and accommodate their concerns while conducting the necessary R&D activities. Concerted effort shall be made to include these groups in determining test parameters and logistics at site-specific locations.
8. Enhance air traffic control procedure assessment tools to better model wake turbulence effects of RNP and DRVSM changes in the National Airspace System.

B. RESOURCES

The intent of this MOA is for the FAA and NASA to manage the joint Wake Turbulence Research Program in accordance with its Wake Turbulence Research Management Plan. This plan should include funding of any cooperative or joint activities consistent with the authority and approved operating plan of each agency. The allocation of agency

resources will be specified by the reimbursable agreement document SOW for each approved activity and will be in concert with the Wake Turbulence Research Management Plan. The SOW will identify the resources such as personnel, facilities, and funding necessary to perform each specified task/activity.

Upon obtaining the appropriate approvals, each agency will utilize its authority to award contracts, grants, and other transactions to accomplish activities under this MOA. Such awards are to be made in accordance with applicable agency/center policies and procedures.

(1) Transfer of Funds

To the extent funds may be transferred between FAA and NASA for services and/or goods provided on a reimbursable basis, pursuant Section 203(c)(5)(6) of the National Aeronautics and Space Act of 1958, as amended, 42 U.S.C. § 2473(c); or sections 226 and 227 of the FAA Reauthorization Act of 1996, 49 U.S.C. § 106 (1)(6) and (m), as applicable, may be cited. The following will apply when transfer of funds for reimbursable work is required; (1) The agency providing the reimbursable services will provide a cost estimate prior to starting the work; (2) The agency requesting the reimbursable services must provide the funds in advance; (3) The agency requesting the services is responsible for the actual costs except for any costs specifically waived by the providing agency. Each task will have its own statement of work, including the costs, but the basic MOA should include these procedural requirements for all tasks that include reimbursable work. Funding transfers will be authorized using approved interagency acquisition documents.

(2) Anti-Deficiency Act

All activities under or pursuant to this MOA are subject to the availability of appropriated funds, and no provision shall be interpreted to require obligation or provision of funds in violation of the Anti-Deficiency Act, 31 U.S.C. § 1341. This MOA is not a funding document and does not represent the obligation or transfer of funds.

C. SCHEDULE

Execution of the Activities outlined in Paragraph 4.A. will span the period of performance of this MOA as specified in Paragraph 8. The individual task schedules will be specified within the SOW for each approved activity and annexed to this MOA.

D. REPORTS AND DELIVERABLES

Technical reports generated from work performed under this MOA will be published and provided as specified in Paragraph 7 by the organization having the primary responsibility, with due acknowledgement and credit given to each organization's

contribution. Research results and deliverables will be released through routine FAA and NASA organizational processes.

E. FACILITIES

To the extent necessary to meet the responsibilities of performing these individual and joint activities, FAA and NASA will make available any facilities necessary to conduct the research activities contained in the specific SOW. Appropriate facility charges will be assessed for any facilities utilized. Certain salary and benefits and other facility charges may be waived for facility usage at NASA and FAA. These waivers will be addressed in the individual SOW and must be approved by the performing agency.

F. PROPERTY LOANS

Each agency may loan property to the other as appropriate to accomplish specified tasks. The agency borrowing property will report any loss, damage, or destruction to the lending agency within ten days. All loans will be made pursuant to the Economy Act, or other reimbursement authority, and will provide for reimbursement by the borrowing agency to the lending agency of any loss, damage, or destruction of the loaned property.

5. REPRESENTATIVES

A. TECHNICAL REPRESENTATIVES

The individuals listed below are responsible for the oversight of this MOA at their respective agencies; however, they do not have the authority to alter any of the terms of this MOA. Any requests for changes must be made in accordance with Paragraph 9.A. of this Agreement. The central point of interagency coordination and information for this MOA is the FAA R&D Field Office at NASA Langley Research Center, Hampton, Virginia.

1. NASA: Wayne H. Bryant; NASA Langley Research Center, MS 264, Hampton, VA 23681; tel. 757-864-1690; fax 757-864-8291; wayne.h.bryant@larc.nasa.gov
2. FAA: George C. Greene; FAA R&D Field Office Manager; NASA Langley Research Center, MS 186, Hampton, VA 23681; tel. 757-864-1905; fax 757-864-1908; george.c.greene@nasa.gov

B. CONTRACTUAL REPRESENTATIVES

If this MOA results in the transfer of funds between FAA and NASA, procurement officials will be designated at the respective headquarters and/or centers. These officials will be listed in the Interagency Agreement for the FAA, or a purchase order for NASA, or other authorized method of intergovernmental funding transfer.

C. DISPUTES RESOLUTION

In accordance and compliance with appropriate FAA and NASA policies and procedures, all representatives will attempt to resolve any disputes arising from the implementation of this MOA. If they are unable to come to agreement on an issue, then the dispute will be referred to the NASA and FAA Program Directors, or their designated representatives, for joint resolution.

6. LIABILITY AND RISK OF LOSS

Each party agrees to assume liability for its own risks associated with agreements and activities undertaken in this MOA.

7. INTELLECTUAL PROPERTY AND DATA RIGHTS

A. DISSEMINATION OF INFORMATION

To the extent permitted by applicable law, the initial release of any information for public consumption, oral or written, concerning results or conclusions made pursuant to performance of this MOA shall require prior written approval of the Technical Representatives, FAA and NASA, named in Paragraph 5A. Both parties recognize the importance of protecting proprietary information from unauthorized disclosures. Protection of proprietary data is considered vital to the success of viable technologies, and both parties will take appropriate measures to assure such protection, consistent with applicable law.

B. PATENT AND INVENTION RIGHTS

Custody and administration of inventions made as a consequence of, or in direct relation to, the performance of activities under this MOA will remain with the respective inventing party. In the event an invention is made jointly by employees of both parties or an employee of a party's contractor, the parties will consult and agree as to the future actions toward establishment of patent protection for the invention.

8. PERIOD OF PERFORMANCE

The period of performance for this research program shall commence upon the effective date of this MOA and shall remain in effect for five (5) years unless terminated by mutual agreement as outlined in Paragraph 9.B.

9. MODIFICATION/AMENDMENTS AND TERMINATION

A. MODIFICATION

This MOA may be modified only upon the mutual written consent of both agencies. Modifications must be signed by the authorized representatives of the FAA and NASA, or their designees. No oral statement by any person shall be interpreted as modifying or otherwise affecting the terms of this MOA.

B. RIGHT TO TERMINATE

Either agency may terminate this MOA upon 180 days written notice to the other agency, signed by the authorized representative of the terminating agency, or the designee of such representative. The notice shall reference the title and identifying number of this MOA, and shall contain the effective date of the termination. Upon termination, each agency will refund any portion of those funds that have been advanced by the other agency, but not yet expended in connection with work under this MOA.

10. Authority

A. NASA

This Agreement is entered into by NASA pursuant to Section 203(c)(5)(6) of the National Aeronautics and Space Act of 1958, as amended, 42 U.S.C. § 2473(c).

B. DOT/FAA

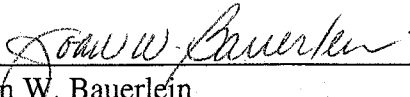
This Agreement is entered into by FAA pursuant to Sections 226 and 227 of the FAA Reauthorization Act of 1996, 49 U.S.C. § 106 (l)(6) and (m).


C. FAA/NASA EXECUTIVE COMMITTEE

This cooperative activity is established under the agreement for cooperation between the FAA and NASA signed by the Administrators on October 9, 1998, entitled "A Partnership to Achieve Goals in Aviation and Future Space Transportation."

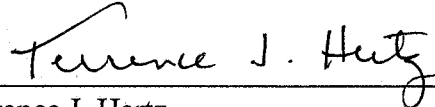
11. APPROVALS

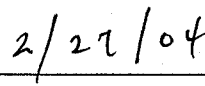
**Federal Aviation Administration/ Air
Traffic Organization**


Joan W. Bauerlein
Director of Operations Planning
Research and Development


Date

**National Aeronautics and Space
Administration/ Office of Aeronautics**


Terrence J. Hertz
Director, Aeronautics Technology Division


Date